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ABSTRACT

Multiple regression in a double cross-validated design was used to predict two performance measures (total variable expense and absence rate) by multi-month period in five industrial firms. The regressions do cross-validate, and produce multiple coefficients which display both concurrent and predictive effects, peaking 18 months to two years subsequent to the first wave of survey measurement. Some evidence of reciprocal causation occurs for absence rate. The human organization characteristics display remarkable constancy across the years separating Waves 1 and 2 of survey measurement. No evidence of curvilinearity was found. It is concluded that the value attribution steps, necessary for a current value human resource accounting system, may be safely attempted. (Author)

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TECHNICAL REPORT

January, 1976

FUTURE PERFORMANCE TREND INDICATORS: A CURRENT VALUE APPROACH TO HUMAN RESOURCES ACCOUNTING

REPORT III

MULTIVARIATE PREDICTIONS OF ORGANIZATIONAL PERFORMANCE ACROSS TIME

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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FUTURE PERFORMANCE TREND INDICATORS: A CURRENT VALUE APPROACH TO HUMAN RESOURCES ACCOUNTING

REPORT III

MULTIVARIATE PREDICTIONS OF ORGANIZATIONAL PERFORMANCE ACROSS TIME

Patricia A. Pecorella
David G. Bowers

This report summarizes Phase I of a two-phase research effort being conducted to develop and refine a current-value human resources accounting procedure. Designed for use by organization decision-makers, the methodology would be geared toward providing "future performance trend indicators." That is, it would provide estimates of the future productive potential of today's human organization. Work in this area has been motivated in large part by the frequent occurrence of seemingly inappropriate management actions concerning human resources utilization and by the belief that key decision makers' lack of certain information fosters ineffective practices.

The situation is perhaps most clearly illustrated by what may be termed the "contingency paradox." A rather substantial body of evidence indicates that better cost performance occurs under a more open, "participative" management system than under a more rigid, "autocratic," tightly directed one (e.g., Likert, 1961, 1967; Drexler & Bowers, 1973; Franklin & Drexler, 1976).

When the question is posed directly to them, senior managers tend to verify this finding in their experience. Yet, when confronted with a need for higher efficiency, managements typically move toward what has been shown to be a less cost effective system--the rigid autocratic one (Likert, 1967).

The problem here is a management system which believes that organizational effectiveness can be attained--if not guaranteed--by (a) demanding particular outputs, and (b) manipulating various aspects of the organization's technical and record-keeping systems. Seeming short run gains do result from these practices: headcount reductions reduce payroll costs; faster equipment allows faster production. The problem, however, is that the gain may be spurious, since long-term loss may instead be the result.

Another example of the contingency paradox is provided by Lawrence and Lorsch (1969). They have found that an organization's structure and functioning should be responsive to the environment in which it operates. More fluid unpredictable environments require internal flexibility and an ability to coordinate creatively. Yet, in contradiction to accepted theory, organizations whose environments become more fluid and less predictable seem, in fact, to turn toward rigid, bureaucratic methods for coping with their uncertainty.

One explanation for these paradoxical practices is that the information systems servicing managers and key decision-makers are deficient. First, these systems typically provide detailed readings on outcomes only, e.g., detailed statements of production for the previous month. No indication is given as to what conditions and events led to the reported outcomes. Furthermore, there is no guarantee that the combination of human organization functional characteristics that led to the outcomes even exist any longer,

although an assumption is made that it does. Second, there exists a time-lag warp in conventional management information systems. They focus almost exclusively upon short-term outcomes and provide little or no data upon the relationship to longer range outcomes of the organization.

There is a need for additional information inputs to management decisions if the inappropriate practices are to be corrected. An improved information system must have the ability to assess the impact of current management procedures upon future effectiveness. That is, we need to recognize that, with increasing complexity comes greater lag time--that the effects of today's human organization practices are felt further into the future than is true in simpler instances. Such being the case, we need an information system that will provide managers with inputs concerning the likely impact (in cost-effective terms) of present conditions upon future outcomes.

The idea of assigning cost-effective values to the human organization is not a new one. Brogden and Taylor (1950) proposed "the development of an overall index of an employee's value to the organization." They went on to suggest that it be calculated in dollar units, determined on a cost accounting basis. Recent attempts to gather these additional measurements are known as Human Resources Accounting (Hermanson, 1964). To date three routes or methods have been conceptualized:

(1) The "Incurred Cost" method -- measuring the amounts already invested in the human organization (Brummet, Pyle, & Flamholtz, 1968; Pyle, 1970a, 1970b).

(2) The "Replacement Cost" method -- estimating the cost of replacing the organization's human resources (Flamholtz, 1969).

(3) The "Present Value" method -- estimating the future productive potential of current human resources (Likert, 1967; Likert, Bowers, & Norman, 1969; Likert & Bowers, 1973).

Our research is concerned with developing and refining a methodology for Human Resources Accounting of a present value type. This approach is generally recognized as theoretically desirable but operationally difficult to implement.

Issues and Problems

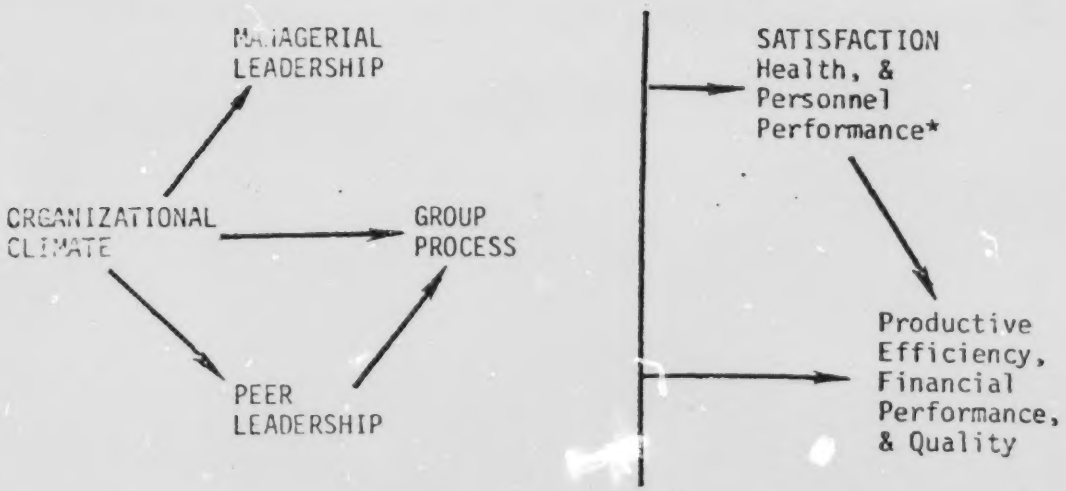
The ability to forecast future productive potential depends upon our possessing adequate knowledge and measurement capabilities in a number of areas.

First, we must have identified the key dimensions of the human organization and acquired the ability to measure these key dimensions accurately. Several theories in the psychological literature propose conceptual models for understanding the functioning of human organizations. Most of them lack the necessary comprehensiveness, however, focusing instead upon one or two isolated constructs, such as "motivation" or "interpersonal relations." In addition, very few of them focus upon the causal flow of events in organizational functioning. Yet theories are needed which describe how the key dimensions interrelate across time.

A notable exception to the general lack of causal flow propositions is Likert's meta-theory, which places constructs in a causal-intervening-end result sequence (Likert, 1961, 1967; Bowers, 1976). Briefly, organizational climate and managerial leadership are viewed as the major causal variables, peer leadership and group process as intervening variables, and satisfaction and performance as end result variables. Figure 1 shows graphically the postulated relationships among these variables. This causal flow of events takes place within a framework of the organization as a system of overlapping groups.

Figure 1

Relationships between Major Social-Psychological Factors and Outcomes



*Personnel performance includes such factors as turnover, grievance rate and absence rate.

(The groups are described as "overlapping" because for all persons below the very top and above the very bottom of the organization, each is a member of two groups simultaneously; he is a subordinate in the group immediately above and a supervisor in the group immediately below.) The dual membership implicit in this fact serves an integrating or linkage function for the organization, that is, it serves to knit together the functions, purposes, and needs of the various parts of the system.

Equally important is the fact that the theory is supported by a wealth of empirical evidence--indeed, it represents a crystallization in conceptual form of a large volume of empirical findings. Its comprehensiveness has been tested in a variety of civilian settings (e.g., Bowers & Franklin, 1976). Its applicability to two military settings has been tested as well (Bowers, 1975a; 1975b), and its major causal statements have been examined with cross-time and cross-echelon analyses (Franklin, 1975a; 1975b).

A survey method has been developed by Taylor and Bowers (1972) for measuring the key dimensions in Likert's meta-theory with reasonable accuracy and objectivity. It utilizes a standard, machine-scored questionnaire entitled the Survey of Organizations (SOO). The questionnaire has been used extensively for both diagnostic and information feedback purposes within organizational development studies. Utilizing Likert's meta-theory and the survey methodology developed to measure its principal dimensions, we believe that the first set of conditions can be met.

Second, we must have valid indicators of the organization's effectiveness. Organizations typically employ multiple criteria to evaluate their performance. Ultimate criteria are those outcomes directly related to the organization's production goals, such as volume, cost, quality, and efficiency. Penultimate

criteria are intermediate rather than end-result outcomes such as attendance, human costs, and resource development. This notion of performance criteria falling into a hierarchy of outcomes has been proposed by other researchers as well (e.g., Seashore, 1965).

While most organizations collect performance data pertinent to one or more of the above criteria, there are several potential constraints on the data's validity. More specifically the validity of performance data become questionable when the following practices occur:

(a) Changing standards or bases differentially from subunit to subunit or period to period,

(b) maintaining common standards for all subunits, but in situations in which the work nature or mix has changed over time drastically and differentially from subunit to subunit,

(c) agglomerating performance information into cost centers which bear little or no resemblance to the real organizational operating structure, and

(d) relying upon collection procedures which systematically distort reported results (Taylor & Bowers, 1972).

It is even possible that performance data are deliberately "fudged" when the control and reward systems of an organization encourage supervisory and non-supervisory employees to protect themselves by reporting inaccurate performance figures. These situations also pose problems for traditional accounting methods and reports used to assess the short-run profitability. Nevertheless, it is important to assess the validity of the performance data to be used in developing future performance trend indicators.

Third, we must establish the relationships between key dimensions of the human organization and performance. Failure to find meaningful, consistent relationships between functional and performance properties of the organization seem to stem from limitations in the data or methods used to investigate them. Sometimes the wrong variables are attended to. At other times the correct variables are measured poorly, with ad hoc measures of questionable reliability and construct validity. Typically, there is a lack of awareness of time lag or insufficient data to assess the time lag operating. When problems in the quality of the survey and organizational data are taken into account and solved, as we feel they have been in the case of the data sets we propose to use, the relationships can emerge.*

Fourth, there must be evidence supporting the durability of changes in organizational functioning and effectiveness. Little research has been conducted on this topic. However, a follow-up study (Seashore & Bowers, 1970) of a highly successful organizational development program suggested that changes in business outcomes, as well as in employee attitudes, that resulted from the formal change program (1962-1964) had persisted several years hence. While but one study, the positive results are encouraging.

Finally, there must be a statistical technique for computing future performance trend indicators. A procedure, developed by Likert and Bowers, (1973) is the one we propose to test and refine. It involves (1) obtaining regression equations between human organization variables and performance variables, (2) converting gains in one to (predicted) gains in the other, (3) removing the standard from the performance measure, and (4) capitalizing

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*See Taylor and Bowers (1972), Pecorella and Bowers (1976a, 1976b) for zero-order analyses of civilian data and Bowers (1973), Franklin and Drexler (1976), Drexler and Franklin (1976) for comparable analyses in military settings.

and discounting the result, based upon estimates of lag times obtained by research.

Relationship of Trend Indicators to Navy Manpower Problems

Future Performance Trend Indicators tie in important ways to the work of Dunnette, et al. (Dunnette et al., 1973; Borman & Dunnette, 1974) which focused on developing a personnel status index for the Navy. Like the ideal product which they conceptualized, this present one would be:

- a single index whose components remain retrievable
- on a scale which permits cross-time comparisons and which is evaluative, not merely descriptive
- capable of providing estimates for organizational entities, not just for individuals
- sensitive to major fluctuations, but resistant to minor ones
- credible to and easily interpreted by a large audience, and reasonably resistant to fudging.

Using a policy capturing methodology, they identified several major components of such an index. Three components stood out as important potential indicators for the Navy: retention rate, discipline (as measured by unauthorized absence rate and rate of less-than-honorable discharges), and readiness (as measured by manning level and maintenance ratings).

Our research is attempting to develop a means of forecasting outcomes of this type based upon key dimensions of the human organization. Caplan and Landekich (1974) say that two steps would be involved in such a venture:

first, estimate the amounts and timing of future benefits; second, estimate the present value of those future benefits. The work to be reported here focuses on the first phase of our project, the phase concerned with the first of these tasks. In the subsequent phase of the research, value attribution will occur: that is, dollar conversions will be undertaken. The method is being tested first in data from civilian sites. Upon successful completion of these analyses, the method will be tested for its generalizability to Navy data sets.

METHODS

Phase I of the project called for multivariate analyses of data in the Organizational Development Research Program's data bank. In this final report for Phase I, data from five industrial organizations (representing continuous process and assembly line manufacturing) were investigated. The data sources, measures, and analysis procedures are described below.

Data Sources

Between 1966 and 1970 data on organizational functioning and performance were collected from several industrial organizations as part of the Michigan Inter-Company Longitudinal Study (ICLS).* Out of six potentially useful data sets from this study, five met all of the criteria necessary for inclusion in the present research:

- at least two waves of comparable organizational functioning data with measures of sufficient internal consistency;
- organizational performance measurements across time with each performance period displaying sufficient internal consistency;

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*The objectives, procedures, and results of ICLS have been described by Likert et al. (1969) and Bowers (1971; 1973).

. zero-order relationships between organizational functioning and performance measures which were directionally appropriate and of sufficient magnitude to merit proceeding with multivariate analyses.

Data meeting these criteria were available from a polyvinyl chloride plant (Organization I), two assembly plants of a large, multi-location manufacturing company (Organization II), a large oil refinery (Organization III), an aluminum extrusion mill (Organization IV) and three paper and cellophane mills of another multi-location company (Organization VI).*

Measures of Organizational Functioning

ICLS was begun in order to make feasible the systematic investigation of relationships between characteristics of the human organization and performance levels of organizational units. The Survey of Organizations questionnaire (SOO), a machine-scored, standardized instrument, was developed as an integral part of this research program. The questionnaire was needed to collect comparable data from diverse organizational sites in an economical and efficient manner. The first version of the SOO was completed in 1966. While modifications have since been made in the questionnaire, most of the "core" measures remained consistent across the ICLS sites.

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*Organization V, a marketing firm, was excluded because its performance measures had been intricately constructed for the special purposes of the ICLS project. They were the source of suspicion concerning their quality then, and this suspicion remains. What the measures produced was a relatively low frequency of directionally correct coefficients.

In its current edition, the SOO includes 124 items focusing on various aspects of the work setting. Six items focus on individual demographic characteristics. Forty-two additional spaces are provided for supplementary questions tailored to a particular organization or study. Responses to most items regarding the work setting are recorded on a five-point extent scale ranging from (1) "to a very little extent" to (5) "to a very great extent." A description of the instrument together with statistical information regarding the validity and reliability of its component elements is provided by Taylor and Bowers (1972) in the questionnaire manual.

Five key dimensions of organizational functioning are measured by the SOO: Organizational Climate, Supervisory Leadership, Peer Leadership, Group Process, and Satisfaction. Organizational climate refers to the organization-wide conditions, policies, and practices within which each work group operates. These conditions and practices are created for a work group by other groups, especially those above it in the organizational hierarchy. Climate conditions set bounds on what does and what can go on within any work group. Aspects of climate can help or hinder conditions within groups, or may do both at the same time.

Supervisory leadership comprises interpersonal and task-related behaviors by supervisors as viewed by their subordinates. Peer leadership comprises analogous interpersonal and task-related behaviors by work group members toward each other. Group process measures those things which characterize the group as a team and whether group members work together well or poorly. The way in which group members share information, make decisions, and solve problems determines the group's effectiveness and the quality of its outputs. Satisfaction measures whether group

members are satisfied with economic and related rewards, the immediate supervisor, the organization as a system, the job as a whole, compatibility with fellow work group members, and present and future progress within the organization.

In its current version, 16 major indexes from the SOO measure these five dimensions of organizational functioning. For the purposes of our present research, two climate indexes (Technological Readiness and Lower Level Influence) have been eliminated due to unsatisfactory reliability (alpha) coefficients displayed in Organizations I through V (see Pecorella & Bowers, 1976). In addition, Organization VI had no measure of group process. Since our multivariate analyses require that all sites have data for all predictors, the group process index was dropped for all the organizations in our sample. Thus, we are left with 13 key SOO indexes as measures of organizational functioning. Brief descriptions of the key indexes are provided in Table 1.

The SOO was administered at least twice to the five organizations discussed in this report with the time between survey administrations ranging from 11 to 24 months. Table 2 lists the dates of the administrations.

Cronbach's Coefficient Alpha (Bohrnstedt, 1969) and Scott's Homogeneity Ratio (Scott, 1960), computed to assess the internal consistency of the 13 major SOO indexes, were reported in two earlier reports (Pecorella & Bowers, 1976a; 1976b). Table 3 summarizes the results of these tests in the five organizations. As the results show, the SOO indexes displayed moderate to high internal consistency,* with alphas averaging .72 to .94 and HR's averaging .58 to .70.

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*It should be noted that statistics on the SOO's internal consistency were computed using group rather than individual data. The data were aggregated because all later analyses will also be conducted at the group level.

Table 1

CRITICAL INDEXES

OF THE SURVEY OF ORGANIZATIONS

Organizational Climate

Decision Making Practices -- the manner in which decisions are made in the system: whether they are made effectively, made at the right level, and based upon all of the available information.

Communication Flow -- the extent to which information flows freely in all directions (upward, downward, and laterally) through the organization.

Motivational Conditions -- the extent to which conditions (people, policies, and procedures) in the organization encourage or discourage effective work.

Human Resources Primacy -- the extent to which the climate, as reflected in the organization's practices, is one which asserts that people are among the organization's most important assets.

Supervisory Leadership

Supervisory Support -- the behavior of a supervisor toward a subordinate which serves to increase the subordinate's feeling of personal worth.

Supervisory Work Facilitation -- behavior on the part of supervisors which removes obstacles which hinder successful task completion, or positively, which provides the means necessary for successful performance.

Supervisory Goal Emphasis -- behavior which generates enthusiasm (not pressure) for achieving excellent performance levels.

Supervisory Team Building -- behavior which encourages subordinates to develop mutually satisfying interpersonal relationships.

Peer Leadership

Peer Support -- behavior of subordinates, directed toward one another, which enhances each member's feeling of personal worth.

Peer Work Facilitation -- behavior which removes roadblocks to doing a good job.

Peer Goal Emphasis -- behavior on the part of subordinates which stimulates enthusiasm for doing a good job.

Peer Team Building -- behavior of subordinates toward one another which encourages the development of close, cooperative working relationships.

Satisfaction -- a measure of general satisfaction made up of items tapping satisfaction with pay, with the supervisor, with co-workers (peers), with the organization, with advancement opportunities, and with the job itself.

Table 2

DATES OF SOO ADMINISTRATIONS

	Time 1	Time 2	Number of Months Between
Organization I	May 1966	May 1967	12
Organization II			
Plant 1	October 1969	October 1970	12
Plant 2	October 1969	September 1970	11
Plant 3	December 1969	January 1971	13
Plant 4	February 1970	February 1972	24
Organization III	April 1968	June 1969	14
Organization IV	July 1969	June 1970	11
Organization VI	April 1966	April 1967	12

Table 3

RELIABILITY OF SOO MEASURES:
MEAN AND RANGE OF ALPHA COEFFICIENTS
AND HOMOGENEITY RATIOS*

	Alpha Coefficients		Homogeneity Ratios	
	Mean	(Range)	Mean	(Range)
Organization I	.72	(.5[illegible]-.86)	.58	(.26-.85)
Organization II	.87	(.71-.91)	.67	(.38-.86)
Organization III	..84	(.67-.94)	.65	(.41-.84)
Organization IV	94	(.78-.94)	.70	(.40-.88)
Organization VI	.85	(.72-.94)	.67	(.36-.85)

*Includes data from Waves 1 and 2 of SOO.

Measures of Performance

In earlier reports (Pecorella & Bowers, 1976a; 1976b; Bowers & Pecorella, 1975) two levels of organizational effectiveness criteria were identified. Ultimate criteria are those organizational outcomes pertinent to the organization's production goals and include variables like volume, cost, quality, and efficiency. Penultimate criteria are intermediate organizational outcomes and include variables like attendance, human costs, and resource development. Four organizations (II, III, IV, and VI) provided a useable general cost measure, referred to here as total variable expense (TVE)*, and four (I, II, III, VI) provided useable measures of total absence (ABS). Definitions of these two measures and the number of months covered by each are provided in Table 4.

Performance data originally provided by the organizations corresponded to different sizes of organizational units. Some data reflected plant performance, some departmental, and still others group performance. An early issue was the appropriate level of aggregation of data for analyses relating the SOO indexes to performance measures. The choices were either to aggregate the SOO data to match the grossest units for which performance data were available (this would reduce the N substantially and also reduce the SOO variance) or to impute performance data to the group level (this would introduce a large number of tied scores, reduce the potential variance in the performance measures, and thus probably depress the correlations between SOO indexes and performance measures). The decision was made to impute performance data to all work groups included in each cost center. Table 5 indicates the original level of aggregation and the N's before and after imputation.

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*Organization I provided a measure of TVE but the data were not useable for reasons discussed by Pecorella and Bowers (1976a).

Table 4

MEASURES OF PERFORMANCE

ORGANIZATION	TVE1	ABS
I. Title		Total Absence
Definition		Number of employees absent in a month as percentage of total number of employees. (High Score = Poor Performance)
Duration		Nov. 1965-Nov. 1967
II. Title	% Production Efficiency	Absence Rate
Definition	Actual manhours worked as percentage of budgeted manhours. (High Score = Poor Performance)	Number of mandays missed as a percentage of number of mandays scheduled. (High Score = Poor Performance)
Duration	Jan. 1969-June 1970	Sept. 1969-May 1970
III. Title	Overtime Labor Costs	Total Absence
Definition	Total overtime as percentage of total scheduled work days. (High Score = Poor Performance)	Total days absent as per centage of total scheduled work days. (High Score = Poor Performance)
Duration	Jan. 1968-April 1969	Jan. 1968-April 1969
IV. Title	% Standard Cost	
Definition	Variance of actual production costs from budgeted costs as a percentage of budgeted costs. (High Score = Poor Performance)	
Duration	July 1969-March 1970	
VI. Title	Total Variable Expense	Total Absence
Definition	Largest actual expense figure from each cost center, encompassing all expenses, as a percentage of the budgeted figures for the cost centers. (High Score = Poor Performance)	Number of employees absent as percentage of the total number of employees.
Duration	Nov. 1965-Aug. 1968	Nov. 1965-Sept. 1966

Table 5

PERFORMANCE DATA - LEVEL OF AGGREGATION

AND N BEFORE AND AFTER IMPUTATION

Organization	Before Imputation Level of Aggregation	N	After Imputation N
I	Plant	3	38
II	Department	18	71 (TVE) 118 (ABS)
III	Department or Division	11	414
IV	Department	6	124
VI	Cost Centers	150 (TVE) 95 (ABS)	193 (TVE) 131 (ABS)

Defining performance periods. One of our preliminary analytic tasks had been to define the size of performance periods, that is, the number of months that a "period" could reasonably be judged to contain for each organization, together with internal consistency (alpha) coefficients for the multi-month periods.

A non-metric technique called Smallest Space Analysis (SSA) was used to identify the performance months to be combined to form the performance periods. The results of these analyses have been discussed in previous reports (Pecorella & Bowers, 1976a; 1976b). Figures 2 and 3 summarize the findings via diagrams which portray the way performance months clustered. In the figures, performance months were ordered relative to when the SOO was first administered. Thus, the performance month occurring one month previous to the first SOO administration was "minus one month" (-1m), the one occurring the same month as the survey was To, the one occurring one month subsequent to the survey was +1m, etc. Each performance month is represented in the figures by a dot. Performance months which the SSA analyses indicated as being close together were circled. Performance months were required to be sequential in order to be clustered into a performance period. The performance periods were labelled A through S.

Within each measure, performance periods were roughly comparable across sites in terms of their time relation to the SOO administration. Performance periods ranged from one to eleven months in absolute length. Our analyses permitted the calculation of internal consistency coefficients for the performance periods. Table 6 summarizes the alpha coefficients and homogeneity ratios calculated for the performance periods comprising of more than one month.

Figure 2

Total Variable Expense - Performance Periods for All Sites

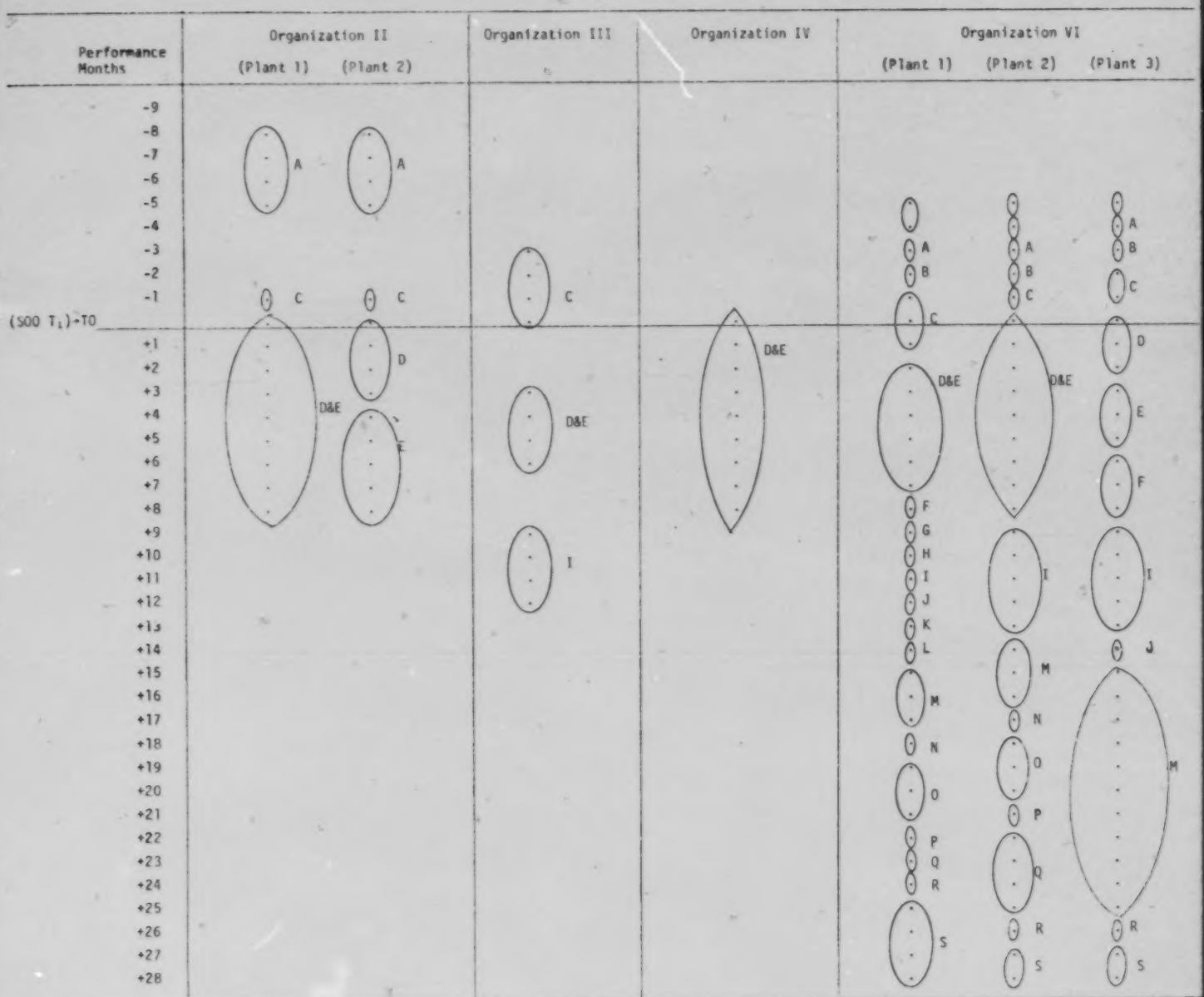

Figure 3

Absenteeism Rate - Performance Periods for All Sites

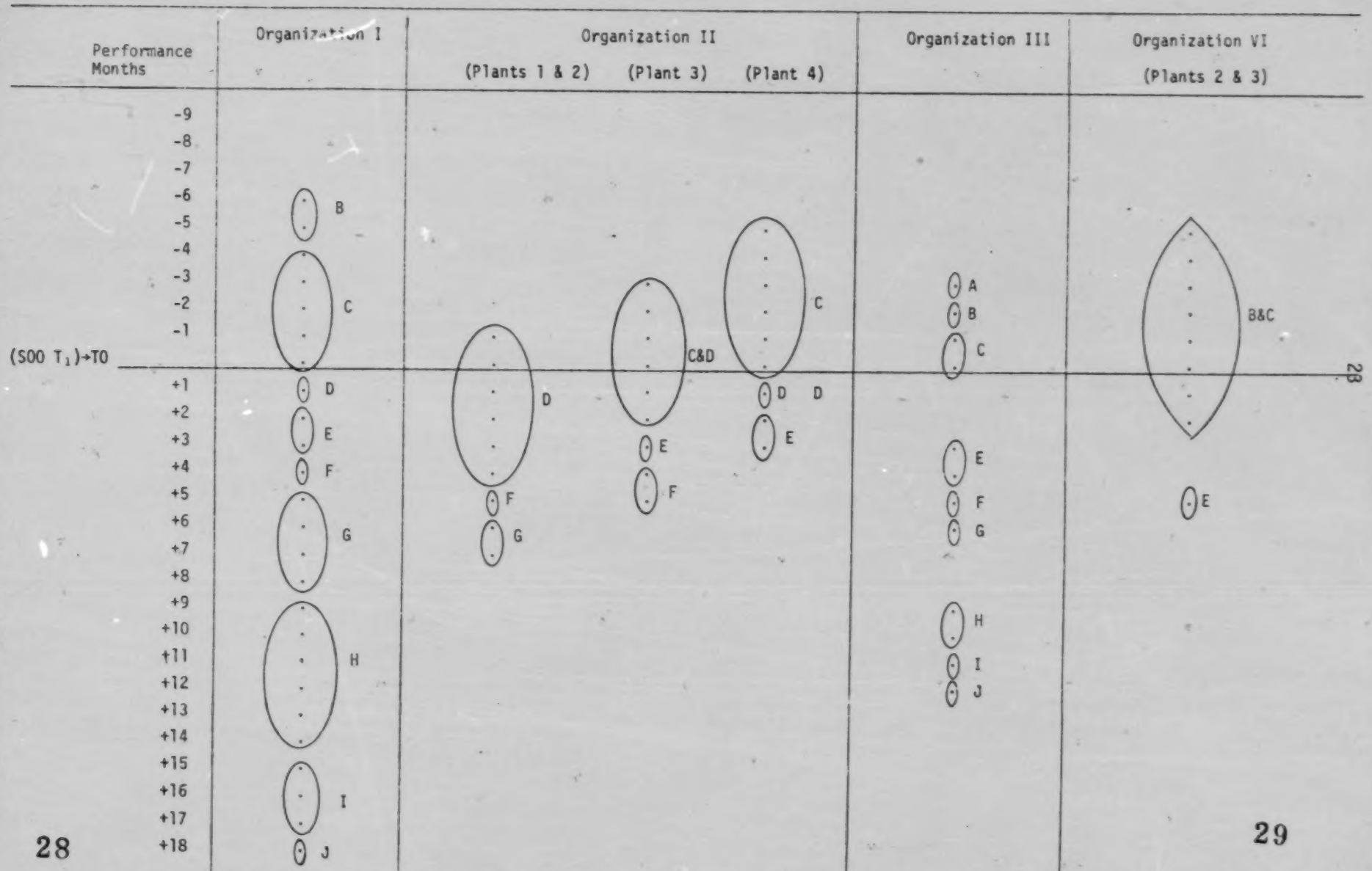

Table 6

RELIABILITY OF PERFORMANCE PERIODS:

MEAN AND RANGE OF ALPHA COEFFICIENTS AND HOMOGENEITY RATIOS

	TVE				ABS			
	Alpha		HR		Alpha		HR	
	Mean	(Range Across Periods)	Mean	(Range Across Periods)	Mean	(Range Across Periods)	Mean	(Range Across Periods)
Organization I	--		--		.88	(.76-.97)	.75	(.62-.94)
Organization II	.92	(.83-.98)	.71	(.48-.93)	.92	(.55-.98)	.78	(.23-.96)
Organization III	.97	(.92-.98)	.89	(.77-.94)	.60	(.46-.74)	.49	(.38-.69)
Organization IV	.94	(.94)	.73	(.73)	--		--	
Organization VI	.89	(.67-.99)	.70	(.43-.99)	.90	(.90)	.90	(.90)

The results were quite encouraging. For TVE, the alphas averaged .89 to .97 and the homogeneity ratios .70 to .89. For ABS, the alphas averaged .60 to .90 and the HR's .49 to .90.

Analysis Procedures

Our research is concerned with developing and refining a methodology for Human Resources Accounting of a present value type. This report describes analyses designed to establish the multivariate relationships between characteristics of the human organization and its organizational effectiveness. As such, it describes the completion of Phase I research activities.

More specifically, performance measures for the included organizations were converted to standard scores based on each organization's score distribution for a particular period. The separate organizational files were then merged into a single master file. For the analyses in relation to total variable expense, as for those in relation to absenteeism, the total sample of groups was split into two sub-samples by randomly assigning the groups in each organization. Each sub-sample was submitted to multiple regression procedures predicting performance from survey scores. The weights derived from each sub-sample were then applied to the survey scores from the other sub-sample, the performance scores predicted, and these predictions correlated with the actual scores. This procedure, termed "double cross-validation" was performed for each performance period and served as a rigorous test of the generalizability and stability of the regression equations produced. It provides the basis for value attribution activities to be attempted in the second phase of the research.

RESULTS

Two research questions were the main focus of analyses reported in this section:

(1) How strong is the multivariate relationship between the human organization and performance, and how stable is it across subsamples of a given population?

(2) What is the lag time between human organization characteristics and their maximum impact on the organization's performance?

Limitations Upon Likely Relationships

Before examining the actual relationship between the human organization and performance, preliminary analyses investigated potential limitations which characteristics of our data sets might have interjected into the findings. At least two issues presented possible constraints upon the relationships that might be obtained.

First, the reliability of the measures might have been sufficiently low that it formed a barrier to predictive validity. While it is not inevitably true that unreliability presents a limit for the validity coefficient (Guilford, 1956, p. 470), much of what has been said on this topic comes from selection testing and seems off-target to the present problem. A constraint in the present case would result if internal consistency was high enough to be acceptable yet far from extremely high, and if this internally consistent variance was largely absorbed by common factor

variance with the criterion. In the present case, therefore, one may reasonably question whether the observed validity coefficients suffer from a "ceiling" effect of limited internal consistency in both the predictor and criterion measures.

The second constraint had to do with differences that have been observed in the magnitude of the zero-order survey-to-performance correlations from one organizational data set to another. (Pecorella & Bowers, 1976a; 1976b). It was our feeling that the differences were related to capital-versus labor-intensiveness. Our expectation was that, in capital-intensive organizations, less performance variance would be tied directly to human organization characteristics.

To assess the likelihood that unreliability of the measures would act as a constraint on the relationships, a method for estimating the expected maximum coefficients of survey with performance measures was employed (Ghiselli & Brown, 1955). The results, presented in Table 7, show that the highest expected validity coefficients range from .69 to .89 for absence and from .80 to . 89 for TVE. These coefficients are sufficiently high to suggest that no serious "ceiling" effect was imposed by the reliability coefficients for the measures.

Tables 8 and 9 summarize the analyses conducted to assess the effects of capital-versus labor-intensiveness upon the zero-order relationships. Three ratios, developed from figures in the 1971 Fortune 500 listing, were used to estimate labor intensiveness:

(1) net sales, including service and rental revenues, in relation to the number of employees;

(2) total assets, less depreciation and depletion, in relation to the number of employees;

Table 7

RELIABILITY LIMITS ON

HIGHEST EXPECTED VALIDITY COEFFICIENTS

Organization	Mean SOO Alpha Coefficients	*Highest Expected Absence Validity Coefficients*	Mean Absence Alpha Coefficients	*Highest Expected TVE Validity Coefficients*	Mean TVE Alpha Coefficients
I	.72	*.80*	.88	--	--
II	.87	*.89*	.92	*.89*	.92
III	.84	*.69*	.60	*.89*	.97
IV	.84	--	--	*.89*	.94
VI	.85	*.89*	.90	*.80*	.89

Table 8

ZERO-ORDER CORRELATIONS BETWEEN SOO AND
ABSENCE IN RELATION TO LABOR INTENSIVENESS

Organization	Ratios Estimating Labor Intensiveness†			Mean of Median Significant Zero-Order Correlations
	Sales/# Employees*	Assets/# Employees**	Stockholder Equity/ # Employees***	
I (Polyvinyl-Chloride Plant)	$ 23,220	$ 23,969	$10,376	.45
II (Assembly-Line)	36,564	23,599	13,978	.50
VI (Paper & Cellophane Mills)	38,169	39,698	20,100	.32
III (Oil Refinery)	130,774	142,064	81,069	.17

*Net sales, including service and rental revenues.

**Total assets, less depreciation and depletion.

***Sum of capital stock, surplus, and retained earnings.

†Figures used for the labor intensiveness ratios were taken from the 1971 Fortune 500 listing.

Table 9

ZERO-ORDER CORRELATIONS BETWEEN SOO AND

TVE IN RELATION TO LABOR INTENSIVENESS

Organization	Ratios Estimating Labor Intensiveness†			Mean of Median Significant Zero-Order Correlations
	Sales/# Employees*	Assets/# Employees**	Stockholder Equity/ # Employees***	
II (Assembly-Line)	$ 36,564	$ 23,599	$13,978	.45
VI (Paper & Cellophane Mills)	38,169	39,698	20,100	.34
IV (Aluminum)	32,755	60,559	28,832	.27
III (Oil Refinery)	130,774	142,064	81,069	.16

*Net sales, including service and rental revenues.

**Total assets, less depreciation and depletion.

***Sum of capital stock, surplus, and retained earnings.

†Figures used for the labor intensiveness ratios were taken from the 1971 Fortune 500 listing.

(3) Stockholder equity (i.e., sum of capital stock, surplus, and retained earnings) in relation to the number of employees.

These three labor-intensiveness estimates were computed for each organization in our data set. Tables 8 and 9 present the average zero-order correlations of survey with performance data for each of the organizations, arrayed by labor intensiveness. The data show that the average correlations between human organization and performance characteristics are higher in the most labor-intensive organizations ($\sim$.45) and lower in the most capital-intensive sites ($\sim$.16). What we must keep in mind, therefore, is that our "composite" organization -- probably like organizations in real life -- contains sub-segments whose performance is more closely related to human organization properties and other sub-segments where this does not hold.

Suitability of the Data Set

Earlier in the report several requirements regarding the reliability and validity of our measures were listed and the data's satisfaction of these requirements considered. Six organizational data sets were originally examined (Pecorella & Bowers, 1976a; 1976b). We found that Organization I's TVE data were apparently subject to the effects of interplay of fixed and variable production costs with corporation-assigned production quotas. While its absence data were included, Organization I was dropped from the TVE analyses. Organization V's performance measures had been intricately constructed for the special purposes of a development project some years ago. Their quality was questionable and they produced a relatively low frequency of directionally correct coefficients Thus, Organization V was also dropped.

Therefore, reliable data remained from ten facilities in five companies:

(A) Absence data from groups in

--a polyvinyl chloride plant (Organization I)

--four assembly plants (Organization II)

--a large oil refinery (Organization III)

--two paper and cellophane mills (Organization VI)

(B) Total Variable Expense data from groups in:

--two assembly plants (Organization II)

--a large oil refinery (Organization III)

--an aluminum extrusion mill (Organization IV)

--three paper and cellophane mills (Organization VI)

In addition to having reliable data, the multivariate analyses to be conducted required a substantial number of cases for each period. Furthermore, our ability to assess the lag time of the human organization's impact on performance depended upon having TVE and absence data that extended across several performance periods. Table 10 reports the periods for which each organization had performance data. The listing indicates that data were available across an extended period of time, although not all organizations had data for all periods. Absence data were available from at least three out of the four organizations for Periods B through H, and from one organization for Periods A, I, and J. There were TVE data for all periods (A through S); however, data were available only from Organization VI for many of those periods. Therefore, in the periods where several organizations provided TVE data, it would be important to investigate the "representativeness" of relationships produced on Orgarization VI's data.

Overall, the data set appeared suitable for the planned multivariate analyses.

Table 10

Organizational Sites with TVE and Absence Data
For Each Performance Period

TVE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Organization II	✓		✓		✓														
Organization III			✓	✓	✓				✓										
Organization IV				✓		✓													
Organization VI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

ABS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Organization I		✓	✓	✓	✓	✓	✓	✓	✓	✓									
Organization II			✓	✓	✓	✓	✓	✓											
Organization III	✓	✓	✓	✓	✓	✓	✓	✓											
Organization VI		✓	✓		✓														

Multiple Regression Analyses: Wave 1 SOO

The analysis design was to split the entire array of groups into two random sub-sample halves, perform multiple regressions on each sub-sample, and then double cross-validate the regressions. Our expectation was that across performance periods we would find a pattern like the one in Figure 4.

The hypothetical relationship portrayed in Figure 4 illustrates two types of effects of the human organization on performance: concurrent and predictive. In other words, characteristics of the human organization were expected to relate to performance at two periods in time. Concurrent relations would be found at the same time the characteristics, as measured by the SOO, existed. (The SOO has been shown to describe a period of up to six months prior to the survey administration.) Predictive relations would appear at some future time, probably several months following the survey administration. The predictive effects were expected to be the stronger and would be evidenced by higher multiple R's in later performance periods than in earlier periods.

Tables 11 and 12 report the multiple regression and cross-validation statistics for the two random sub-samples. The 13 key SOO indexes were the predictors of total variable expense and absence. First of all, a number of the sub-sample R's were moderately high and statistically significant: the coefficients for total variable expense ranged from .24 to .78 and seven out of 18 of them were significant beyond the .05 level. For six out of the nine TVE performance periods tested in this way, and at least one sub-sample had a statistically significant R (see Table 11).* The coefficients for absence (ABS) ranged from

*Only Periods A through I were cross-validated because Periods J through S included data from only Organization VI. This meant that too few cases were generally available for the cross-validation procedures.

Figure 4

HYPOTHETICAL RELATIONSHIP BETWEEN

THE HUMAN ORGANIZATION AND PERFORMANCE

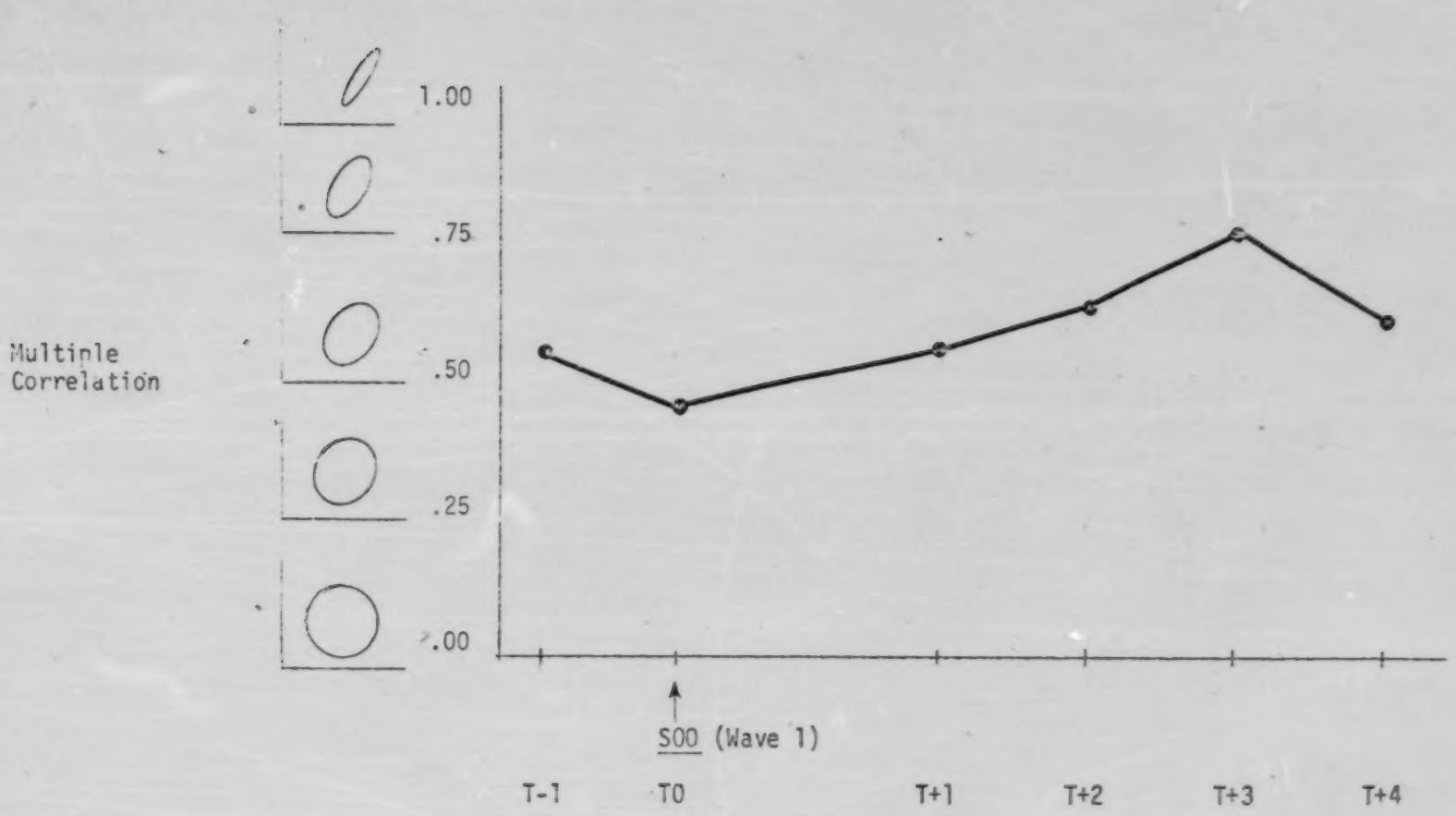

Table 11

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO TVE SUB-SAMPLES: SOO WAVE 1 INDEXES AS PREDICTORS

SOO T_1

	A	B	C	D	E	F	G	H	I
Sub-Sample 1									
R	.39	.39	.42	.32	.38	.47	.78	.65	.29
N	92	64	219	254	219	100	24	24	201
p	.38	.77	.01	.01	.01	.04	.38	.83	.23
Sub-Sample 2									
R	.55	.42	.35	.25	.24	.45	.69	.73	.37
N	96	63	223	255	223	98	27	27	208
p	.01	.64	.01	.22	.47	.08	.56	.41	.01
Cross-Val. R's									
Sub-sample 1 from sub-sample 2 weights	.30 p<.01	.23 p<.06	.22 p<.01	.23 p<.01	.21 p<.01	.16 p<.11	too few cases to cross-validate		.06 p<.33
Sub-sample 2 from sub-sample 1 weights	.42 p<.01	.23 p<.07	.24 p<.01	.18 p<.01	.13 p<.07	.20 p<.05			.11 p<.12

Table 12

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO ABSENCE SUB-SAMPLES: SOO WAVE 1 INDEXES AS PREDICTORS

	A	B	C	D	E	F	G	H	I	J
Sub-Sample 1										
R	.52	.35	.43	.50	.23	.40	.38	.50	.58	.49
N	127	190	211	58	211	171	164	142	131	131
p	.01	.04	.01	.36	.64	.01	.03	.01	.01	.01
Sub-Sample 2										
R	.46	.30	.30	.55	.27	.30	.34	.46	.51	.39
N	127	199	224	37	224	147	139	135	135	135
p	.01	.16	.07	.69	.21	.44	.24	.01	.01	.97
Cross-Val. R's										
Sub-sample 1 from sub-sample 2 weights	.44 p<.01	.25 p<.01	.28 p<.01	-.04 p<.74	.03 p<.65	.21 p<.01	.26 p<.01	.43 p<.01	.50 p<.01	.34 p<.01
Sub-sample 2 from sub-sample 1 weights	.40 p<.01	.21 p<.01	.20 p<.01	-.08 p<.65	.08 p<.21	.14 p<.10	.23 p<.01	.38 p<.01	.42 p<.01	.44 p<.01

.23 to .58 and 13 out of 20 of them were significant beyond the .05 level. For eight out of the 10 ABS performance periods, at least one sub-sample R was statistically significant (see Table 12).

Secondly, the cross-validation R's were significant for all but two TVE periods (F and I) and all but two ABS periods (D and E). These results suggested that the human organization characteristics were indeed related to performance and that the obtained relationships would probably hold up in other samples drawn from similar populations.

Each of the performance measures was then submitted to a similar set of analyses using the entire array of data. Table 13 shows the results for TVE. The R's ranged from .27 to .70; more than one third of the multiple correlations were significant ($p<.05$). Table 14 shows the results for absence. In this case the R's ranged from .20 to .53 with 80% of the coefficients significant beyond the .01 level.

By blocking the periods into multi-period "Spans," we obtained some evidence of lag times. The spans were based upon the average numbers of months each site had in each performance period. Table 15 shows the mean Multiple R for each of seven TVE Spans and four ABS Spans. The reading for SOO Wave 1, taken between Spans 1 and 2, has been shown to reflect six to twelve months previous to the survey measurement (Taylor & Bowers, 1972). Thus the R's for Spans 0 and 1 reflect concurrent effects of the human organization upon performamce. Spans 3 through 7 reflect predictive effects.

In the case of TVE, the mean R's for Organization VI alone were also computed. This was done because, as was described earlier, data for TVE periods J to S were available only from Organization VI, while several of

Table 13

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 1 SOO INDEXES AS PREDICTORS OF TVE

	TVE Periods									
	A	B	C	D	E	F	G	H	I	
Entire Sample										
R	.46	.38	.34	.27	.27	.40	.57	.48	.26	
N	188	127	442	509	442	198	51	51	409	
p	.01	.16	.01	.01	.01	.01	.23	.58	.01	
	J	K	L	M	N	O	P	Q	R	S
R	.28	.70	.57	.35	.38	.47	.37	.54	.35	.29
N	124	51	51	186	79	79	79	49	108	108
p	.76	.01	.22	.11	.59	.18	.69	.37	.43	.79

Table 14

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 1 SOO INDEXES AS PREDICTORS OF ABSENCE

	A	B	C	D	E	F	G	H	I	J
Entire Sample										
R	.47	.30	.33	.34	.20	.32	.33	.43	.53	.43
N	254	389	435	128	435	351	290	290	266	266
p	.01	.01	.01	.33	.18	.01	.01	.01	.01	.01

Table 15

EVIDENCE OF LAG TIME:

MULTIPLE REGRESSION STATISTICS ACROSS SEVERAL TIME SPANS (WAVE 1 S00)

	Span 1	Span 2	Span 3	Span 4	Span 5	Span 6	Span 7
	5 mos. prior to S00 Wave 1 (Periods A&B&C)	6 mos. subsequent to S00 Wave 1 (Periods D&E)	Mos. 7 & 8 subsequent to S00 Wave 1 (Period F)	Mos. 9 - 16 subsequent to S00 Wave 1 (Periods G&H&I)	Mos. 17 - 26 subsequent to S00 Wave 1 (Periods J&K&L&M)	Mos. 27 - 31 subsequent to S00 Wave 1 (Periods N&O&P)	Mos. 32 - 37 subsequent to S00 Wave 1 (Periods Q&R&S)
TVE							
Entire Sample							
Mean R	.39	.27	.40	.44	.48	.41	.39
Control Org. (VI)							
Mean R	.34	.34	.35	.46	.48	.41	.38

	Span 0	Span 1	Span 2	Spans 3/4
	Mos. 7 - 12 p prior to S00 Wave 1 (Periods A&B)	6 mos. prior to S00 Wave 1 (Period C)	6 mos. subsequent to S00 Wave o (Periods D&E&F)	Mos. 7 - 14 subsequent to S00 Wave 1 (Periods G&H&I&J)
ABS				
Entire Sample				
Mean R	.38	.33	.29	.43

the organizations (including Organization VI) provided data for Periods A to I. If the R's for Periods J to S were to be taken as representative of our larger sample of organizations therefore, the mean R's for the earlier periods for Organization VI would need to correspond to the mean R's for the total sample for those same periods. The results in Table 15 indicate that Organization VI's data resembled quite closely the data of our total sample and were thus likely to be representative.

As far as the data extended, the results were strikingly similar for TVE and ABS. The TVE relationships would appear to peak in Span 5 (Mean R = .48), 17-26 months following the first survey administration, and then begin to decline. The data for ABS only extended as far as Span 3, but were rising at that point.

While the rise and fall were not as dramatic as our hypothetical chart depicted them, they were there and followed a pattern very similar to the one hypothesized. The relationships varied around a value of .40, peaking at a somewhat higher value eighteen months to two years after the Wave 1 SOO measurement and two and one-half to three years after the presumed on-set of the organizational conditions measured (i.e., from Spans 0 and 1).

The coefficients, by their magnitude, reflect the "smoothing" effect of our blocking of the performance measures into "periods" and "spans." These blockings contain months in which the relationships are much stronger than .40 as well as months in which they are much weaker, or even zero. Thus, the relationships appeared considerably more "even" than would be true with finer slicings.

Multiple Regression Analyses: Wave 2 SOO

Parallel analyses were conducted to investigate the relationship between performance and the human organization measures using Wave 2 SOO data. In most cases, the second administration of the SOO followed the first by about one year. Since we expected similarity in the social systems characteristics over that year (and thus in the measurements obtained), we expected the relationships to performance to be similar but slightly weaker for early spans of performance data (i.e., Spans 0-3). The strength of the relationships for these Spans relative to those obtained with Wave 1 SOO data would be expected to decline as the correlations between the waves of survey data declined.

On the other hand, we expected the relationships during later performance spans (e.g., Spans 4-7) to be as strong as or stronger than those for Wave 1. Concurrent and predictive effects relative to the second survey administration were expected to emerge during the later Spans.

Tables 16 and 17 report the multiple regression and cross-validation statistics for two random sub-samples using wave 2 of the SOO data. The results corresponded closely to our expectations. First of all, several of the TVE sub-sample R's were moderately high, although few of them were statistically significant: the coefficients for TVE ranged from .23 to .73; four out of 18 were significant beyond the .05 level (see Table 16).*

*As with SOO Wave 1 data only Periods A through I were cross-validated because Periods J through S included data from only Organization VI. This meant that too few cases were generally available for the cross-validation procedures to be applied.

Table 16

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO TVE SUB-SAMPLES: SOO WAVE 2 INDEXES AS PREDICTORS

SOO T_2

	A	B	C	D	E	F	G	H	I
Sub-Sample 1									
R	.47	.56	.28	.35	.24	.37	.72	.70	.23
N	95	65	204	265	206	127	29	29	197
p	.07	.06	.27	.01	.53	.16	.34	.43	.65
Sub-Sample 2									
R	.34	.51	.31	.25	.36	.45	.59	.73	.38
N	93	65	204	261	203	125	27	27	195
p	.67	.21	.10	.23	.01	.01	.66	.41	.01
Cross-Val. R's									
Sub-sample 1 from sub-sample 2 weights	.06 p<.55	.23 p<.06	.09 p<.19	.18 p<.01	.04 p<.52	.18 p< 05	too few cases to cross-validate		.09 p<.20
Sub-sample 2 from sub-sample 1 weights	.10 p<.37	.19 p<.14	.08 p<.26	.14 p<.02	.12 p<.09	.30 p<.01			.08 p<.26

Table 17

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO ABSENCE SUB-SAMPLES: SOO WAVE 2 INDEXES AS PREDICTORS

	A	B	C	D	E	F	G	H	I	J
Sub-Sample 1										
R	.61	.39	.39	.35	.28	.36	.35	.52	.50	.52
N	111	182	190	50	190	157	159	145	135	135
p	.01	.01	.01	.96	.33	.09	.09	.01	.01	.01
Sub-Sample 2										
R	.64	.39	.42	.66	.42	.40	.37	.32	.52	.33
N	110	178	185	46	185	152	155	141	132	132
p	.01	.01	.01	.07	.01	.02	.05	.32	.01	.34
Cross-Val. R's										
Sub-sample 1 from sub-sample 2 weights	.52 p<.01	.22 p<.01	.34 p<.01	.15 p<.31	.05 p<.50	.20 p<.01	.11 p<.16	.28 p<.01	.42 p<.01	.23 p<.01
Sub-sample 2 from sub-sample 1 weights	.52 p<.01	.20 p<.01	.35 p<.01	.35 p<.02	.24 p<.01	.17 p<.04	.10 p<.20	.18 p<.03	.40 p<.01	.10 p<.25

The coefficients for ABS were better. They ranged from .28 to .66 with 13 out of 20 of the correlations significant beyond the .05 level. For nine out of ten ABS performance periods, at least one sub-sample R was statistically significant (see Table 17).

The cross-validation R's for TVE were only significant ($p<.10$) in Periods B, E, and I. Again, the ABS results were stronger. The cross-validation R's were significant for all but one ABS period (Period G). These results suggested that the Wave 2 SOO measurements were related to early performance periods but that the results for TVE were weaker than those for ABS and weaker than the results obtained for SOO Wave 1 data. The differences related to the SOO waves were expected. The findings regarding TVE versus ABS were also not surprising. The stronger, more consistent relationships between the SOO and ABS were noted in an earlier report (Pecorella & Bowers, 1976a) and were also found with Wave 1 data in the previous section. The stronger relationships were never more striking than in the present findings, however. These findings seem to support the notion that penultimate criteria, such as absenteeism, are more likely to remain in close contact with and responsive to aspects of human organization functioning than are ultimate criteria such as cost performance.

Next, each of the performance measures were submitted to similar analyses using the entire array of wave 2 data. Table 18 shows the results for TVE. The R's ranged from .18 to .62; three out of the 19 multiple correlations were significant ($p<.05$). Table 19 shows the results for ABS. The R's for ABS ranged from .28 to .59 with 90% of the coefficients significant beyond the .05 level.

Table 18

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 2 SOO INDEXES AS PREDICTORS OF TVE

Entire Sample	A	B	C	D	E	F	G	H	I	
R	.26	.34	.23	.27	.21	.37	.55	.46	.18	
N	188	130	408	526	409	252	56	56	392	
p	.44	.31	.06	.01	.16	.01	.19	.57	.43	
	J	K	L	M	N	O	P	Q	R	S
R	.33	.50	.62	.35	.47	.42	.33	.59	.37	.39
N	129	56	56	159	87	87	81	52	117	120
p	.36	.41	.04	.11	.10	.30	.81	.14	.26	.14

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Table 19

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 2 SOO INDEXES AS PREDICTORS OF ABSENCE

	ABS Periods									
	A	B	C	D	E	F	G	H	I	J
Entire Sample										
R	.59	.33	.39	.42	.30	.33	.28	.36	.49	.34
N	221	360	375	96	375	309	314	286	267	267
p	.01	.01	.01	.20	.01	.01	.02	.01	.01	.01

The periods were then blocked into the same multi-period spans as were used for wave 1 data. Table 20 shows the mean multiple R for each of the seven TVE Spans and the four ABS Spans. In this case Spans 3 and 4 would contain concurrent effects and Spans 5, 6, and 7 predictive effects. Relationships in Spans 0 through 2 would represent "shadow" effects -- that is, relationships resulting from the carryover of social system properties from one year to the next.

Once again, the mean R's for Organization VI alone were also computed for the TVE periods, and they served as an indicator of the validity of coefficients in Periods J-S for which only Organization VI provided data. The results in Table 20 indicate that Organization VI's data were quite close to the data for the total wave 2 sample.

For TVE there were signs of both concurrent and predictive effects. The multiple R's were in the 20's during Spans 1 and 2 ("shadow" periods), in the 30's during Spans 3 and 4 ("concurrent" periods) and in the 40's during Spans 5-7 ("predictive" periods). The predictive effects were again the strongest. It is likely, however, that our data did not extend far enough to pick up the peak relationship to Wave 2 survey measures.

Table

EVIDENCE OF LAG TIME:

MULTIPLE REGRESSION STATISTICS ACROSS SEVERAL TIME SPANS (WAVE 2 S00)

	Span 1	Span 2	Span 3	Span 4	Span 5	Span 6	Span 7
	Mos. 17 - 21 prior to S00 Wave 2 (Periods A&B&C)	Mos. 11 - 16 prior to S00 Wave 2 (Periods D&E)	Mos. 9 & 10 prior to S00 Wave 2 (Period F)	8 Mos. prior to S00 Wave 2 (Periods G&H&I)	10 Mos. subsequent to S00 Wave 2 (Periods J&K&L&M)	Mos. 11 - 15 subsequent to S00 Wave 2 (Periods N&O&P)	Mos. 16 - 21 subsequent to S00 Wave 2 (Periods Q&R&S)
TVE							
Entire Sample							
Mean R	.28	.24	.37	.39	.44	.40	.45
Control Org. (VI)							
Mean R					.44	.40	.45

	Span 0	Span 1	Span 2	Span 3/4
	Mos. 20 - 25 prior to S00 Wave 2 (Periods A&B)	Mos. 14 - 19 prior to S00 Wave 2 (Period C)	Mos. 8 - 13 prior to S00 Wave 2 (Periods D&E&F)	7 Mos. prior to & including month of S00 Wave 2 (Periods G&H&I&J)
-BS				
Entire Sample				
Mean R	.46	.39	.35	.36

Comparisons Between Two Waves of Survey Data

Figures 5 and 6 portray the relationship between the Survey of Organizations indexes and performance (i.e., TVE and ABS) across time. The R's obtained for both waves 1 and 2 of the survey data are plotted.

The similarity in shape of the two curves (Wave 1 SOO versus performance and Wave 2 SOO versus those same performance period scores) suggests that the social systems in place at these two points in time were themselves quite similar. Despite the fact that a full year had intervened between the two benchmark points (in most instances a year of some form of intervention activity), comparative stability, not radical change, seems to have occurred. Much of what we see at the time of wave 2 represents the persistence in time of a set of conditions and properties which existed at the time of wave 1. This is borne out in the pattern of inter-wave correlations presented in Table 21. Here we see the maximum possible coefficients (the square root of the cross product of the two alpha coefficients) compared to the actual inter-wave coefficients. As the data indicate, the amount of inter-wave correlation is substantial, although it does not saturate all available variance. There is room for movement to evidence itself, but there is as well a high degree of inter-wave similarity

The problems involved in interpreting lagged effects with multiple waves of discrete predictor variables are illustrated by the graphs in Figure 7. In section (a) of this figure, we see what our expectation would be for a behavior segment one month long and a lag of six months in total cycle time.

Figure 5

Relationships Between SOO and TVE Across Time:

Comparisons Between SOO Waves 1 and 2

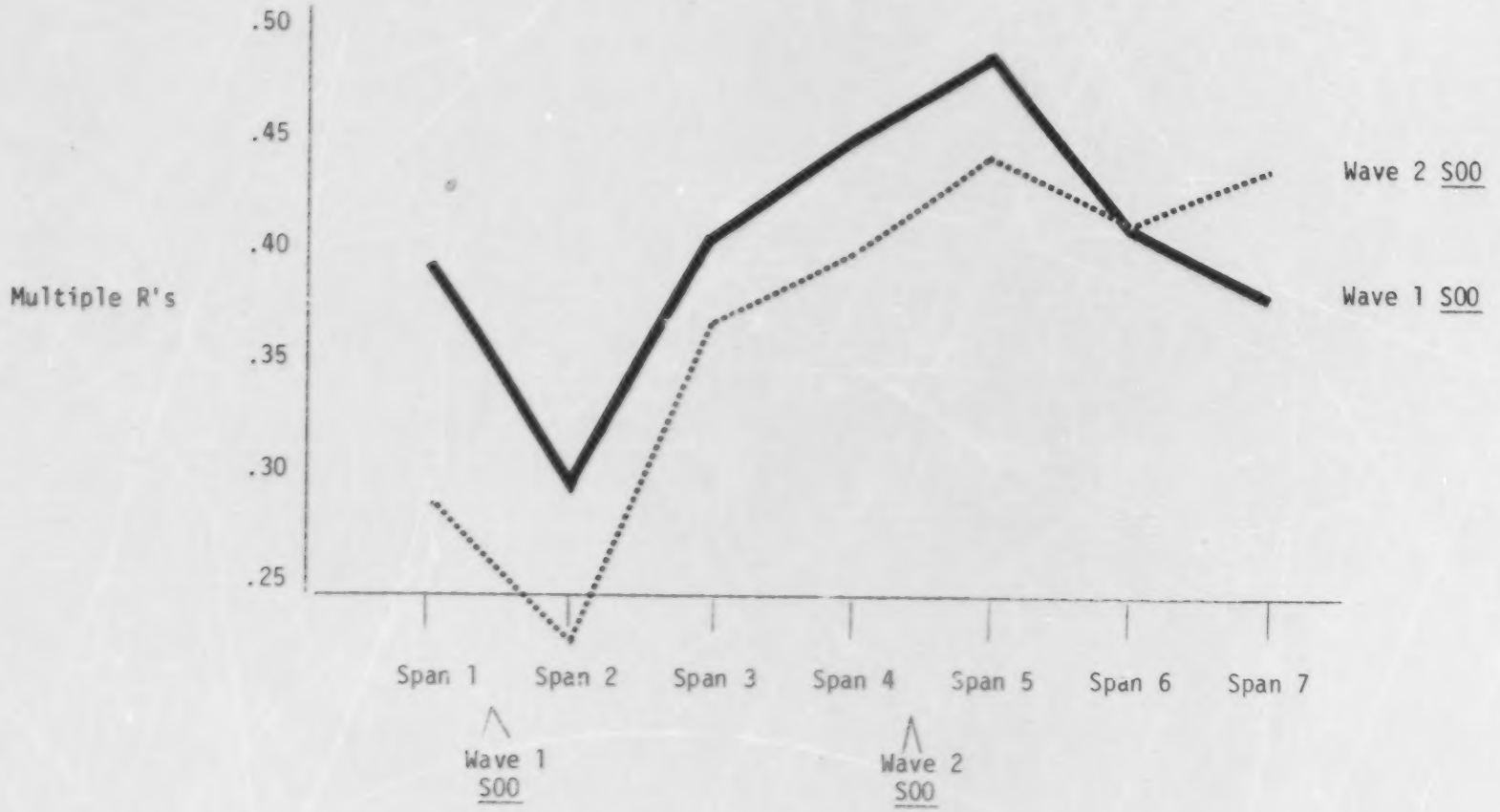


Figure 6

Relationships Between SOO and TVE Across Time:

Comparisons Between SOO Waves 1 and 2

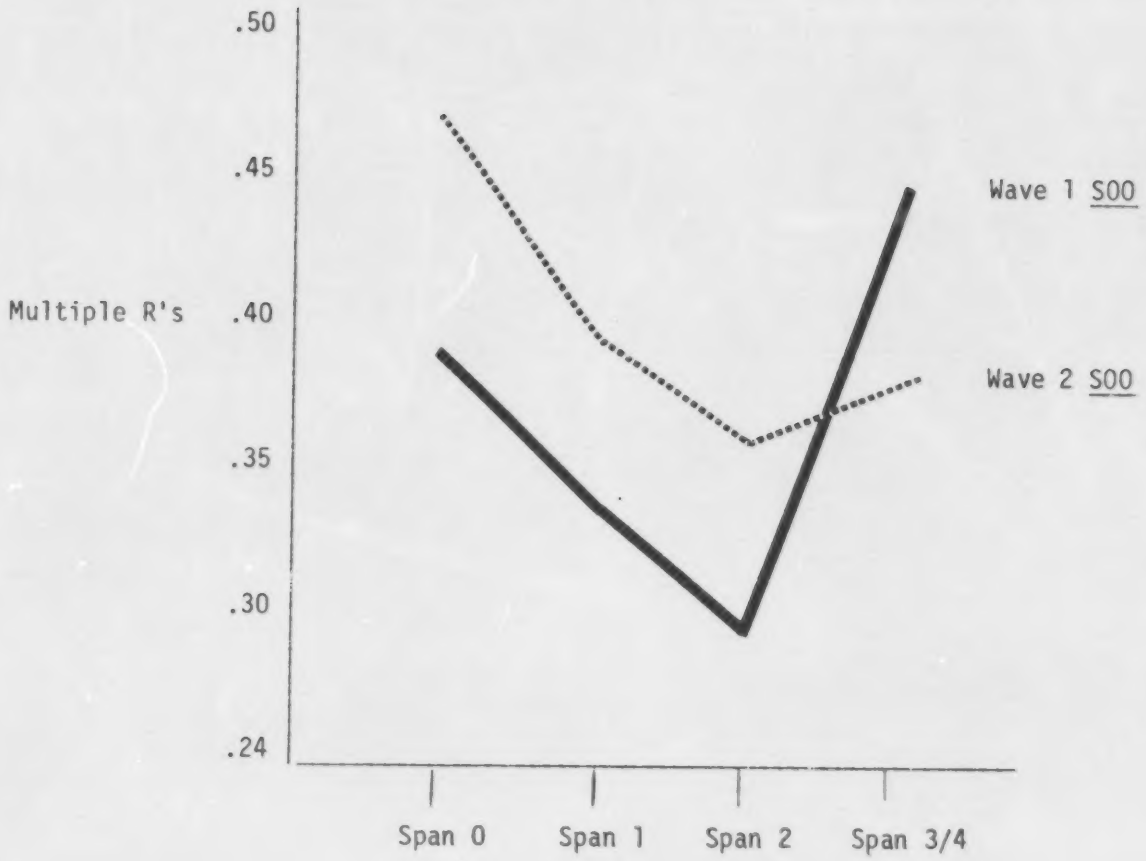


Table 21

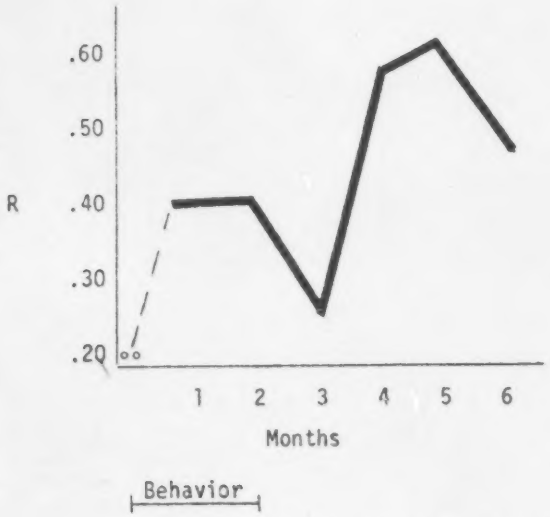
MAXIMUM POSSIBLE AND ACTUAL INTER-WAVE CORRELATIONS

(N = 507 Work Groups)

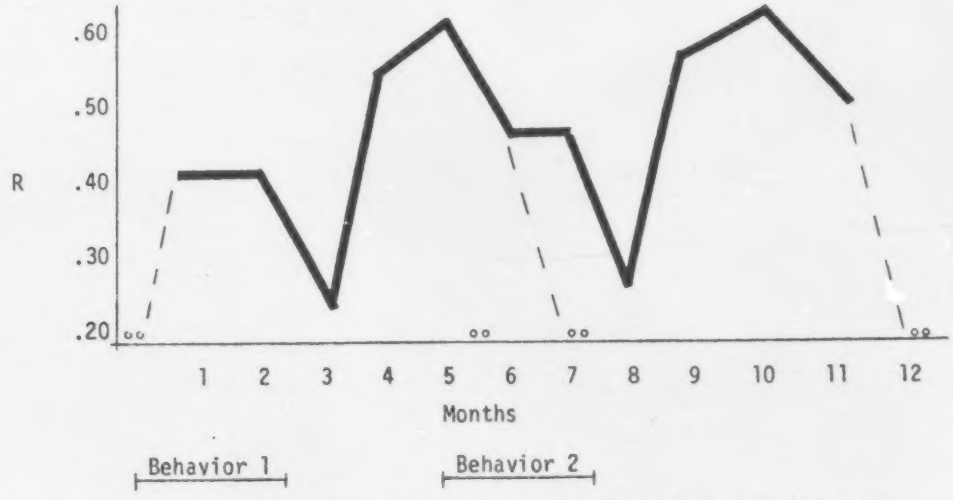
Index	(Across Organizations) Mean Alpha Coefficients		Maximum Possible Inter-Wave Coefficient	Actual Inter-Wave Coefficient
	Wave 1	Wave 2		
Decision Making Practices	.80	.86	.83	.61
Communication Flow	.77	.82	.79	.57
Motivational Conditions	.74	.81	.77	.62
Human Resources Primacy	.86	.88	.87	.71
Supervisory Support	.91	.93	.92	.50
Supervisory Goal Emphasis	.78	.87	.82	.51
Supervisory Work Facilitation	.88	.91	.89	.46
Supervisory Team Building	.86	.89	.87	.51
Peer Support	.86	.89	.87	.34
Peer Goal Emphasis	.80	.83	.81	.34
Peer Work Facilitation	.87	.88	.87	.36
Peer Team Building	.86	.91	.88	.34
Satisfaction	.78	.82	.80	.55

Figure 7

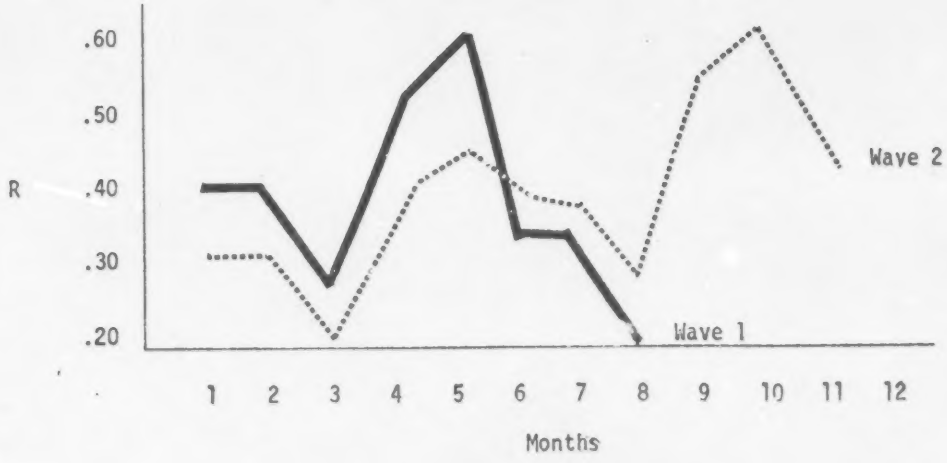
Interpreting Lagged Effects with Multiple Waves of Predictor Measurements: A Hypothetical Case



One-month duration, single cycle (a)



One-month duration, two single cycles (behaviors unrelated to each other) (b)



One-month duration, two single cycles (behaviors similar, but not identical) (c)

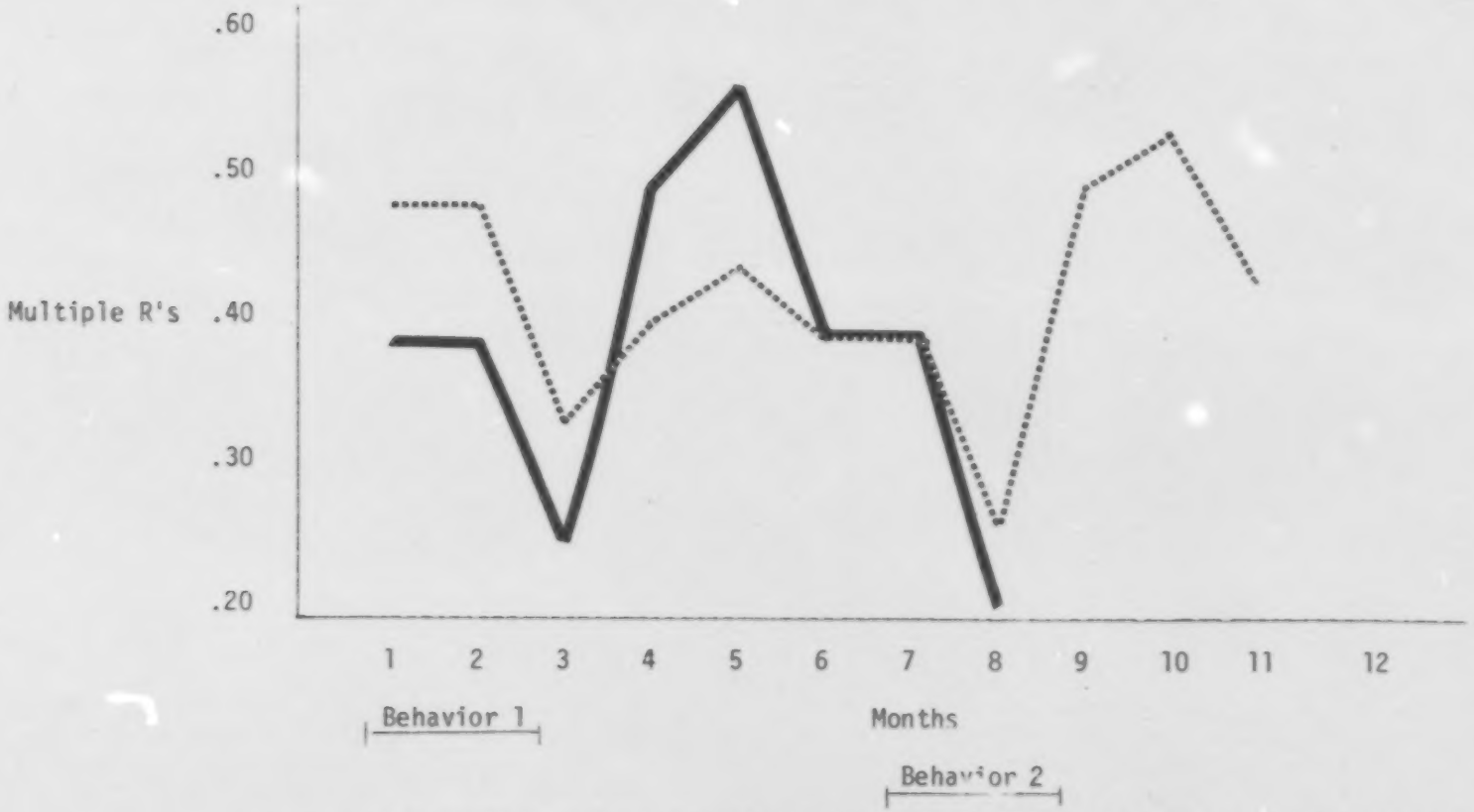
The bimodal shape is obvious, with smaller (concurrent) and larger (predicted) "humps." Section (b) displays a sequence of two cycles whose behavior segments are unrelated to one another. Two separate waves of identical shape are hypothesized. Section (c) displays the more likely finding. Here we see a sequence of two cycles whose behavior segments are very similar, although not identical. Here we see that each cycle has a "ghost" -- a figure whose shape roughly duplicates that of the current cycle, but at a lower level. A simpler way of saying this would be, for example, that Behavior 2 should be related to performance in month 1 at a level slightly below the relationship displayed by Behavior 1. The ghost or shadow continues until one overtakes months 6 and 7, which are concurrent to Behavior 2. At this point Behavior 2 assumes the higher or "lead" role. This, in fact, is what our results suggested. The pattern in part (c) of the figure emerged more clearly with TVE than with the ABS measure, but was present to some degree for both.

Yet another problem is evidenced in Figure 8. Here we see again two cycles, each displaying a single month of behavior. As before, the behaviors are similar, but not identical. In this instance, however, some amount of "reverse" causation is evidenced; that is, Behavior 2 is in some measure the result of performance in months 1-3, as well as the cause of performance in months 6-11. This is shown in the figure by the fact that relationships of Behavior 2 to performance in those early months are higher than relationships of Behavior 1 to performance in those same months. Such "reciprocal causation" is no doubt always present, although the comparative amounts in one direction or the other provide us with what we normally term a "causal thrust." When the curve in the preceding cycle (for a later behavior segment) is higher than the curve in the same cycle for the earlier segment and higher

Figure 8

Interpreting Lagged Effects Using Multiple Waves of Measurement

A Hypothetical Case of Reciprocal Causation



One-month duration, two single cycles, behaviors similar but not identical, with some amount of "reverse" causation.

than the curve for that later segment's own contemporary cycle, we say that organizational practices are "caused" by performance in the preceding period. When the reverse occurs, we say that behavior "causes" performance. In instances such as that diagrammed in Figure 8, in which both effects are apparent, we term it "reciprocal causation." The relationships obtained for Absence seem to fit this latter pattern.

Two Remaining Issues

As final footnotes to a main body of findings, it seemed appropriate to examine rather specifically results concerned with two issues: (a) what the multiple regression results are at the monthly level (as opposed to aggregated "periods" of months), and (b) whether there is reasonable likelihood of curvilinearity in relationships which we have treated thus far as linear.

Regressions by Month. The multiple regressions predicting total variable expense and absenteeism monthly scores (again standardized within sites) from SOO indexes were repeated for Waves 1 and 2 of survey data. The results (presented in Tables 22, 23, 24, and 25) confirm our expectations. The coefficients, while statistically significant with a frequency for exceeding chance (40 to 67 percent significant beyond the .05 level, for example), are generally somewhat lower than those predicting performance scores for multi-month periods. This is particularly true in the later months, where cases become fewer and where pooling months into periods adds reliability to the performance measures. There are, however, occasional coefficients which attain very high values, again as we expected. It appears, therefore, that we can safely disregard monthly performance measures, since analyses at this level appear to provide us with little that is not obtained with greater confidence at a more aggregated level.

Table 22

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:
WAVE 1 SOO INDEXES AS PREDICTORS OF TVE BY MONTH

	TVE MONTHS												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Entire Sample													
R	.81	.81	.81	.82	.41	.28	.29	.35	.42	.32	.44	.34	.27
N	61	61	61	61	127	127	381	442	381	509	244	251	509
P	.01	.01	.01	.01	.06	.69	.01	.01	.01	.01	.01	.01	.01
	13	14	15	16	17	18	19	20	21	22	23	24	25
R	.27	.29	.23	.39	.33	.23	.24	.26	.27	.40	.22	.39	.34
N	509	509	513	192	192	415	409	409	409	161	161	156	156
P	.01	.01	.01	.01	.01	.06	.04	.01	.01	.01	.86	.03	.14
	26	27	28	29	30	31	32	33	34	35	36	37	
R	.32	.21	.22	.32	.38	.31	.32	.21	.30	.34	.36	.23	
N	156	156	156	156	149	119	119	113	113	113	114	119	
P	.28	.91	.88	.26	.06	.61	.53	.98	.70	.44	.35	.95	

59

Table 23

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:
WAVE 1 SOO INDEXES AS PREDICTORS OF ABS MY MONTH

	ABS MONTHS												
	1	2	3	4	5	6	7	8	9	10	11	12	
Entire Sample													
R	.82	.32	.26	.34	.28	.29	.27	.23	.20	.26	.25	.28	
N	21	166	166	435	435	496	496	242	242	382	351	465	
P	.46	.20	.62	.01	.01	.01	.01	.43	.76	.02	.06	.01	
	13	14	15	16	17	18	19	20	21	22	23	24	25
R	.35	.49	.80	.53	.26	.52	.40	.86	.73	.98	.83	.85	.86
N	336	82	21	272	266	266	266	18	18	18	18	18	18
P	.01	.08	.56	.01	.13	.01	.01	.61	.93	.02	.72	.65	.64

Table 24

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:
WAVE 2 SOO INDEXES AS PREDICTORS OF TVE BY MONTH

	TVE MONTHS												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Entire Sample													
R	.62	.52	.56	.52	.43	.30	.28	.26	.34	.21	.30	.31	.24
N	57	57	57	57	131	131	351	408	351	526	294	300	526
P	.04	.28	.15	.30	.03	.56	.01	.01	.01	.03	.02	.01	.01
	13	14	15	16	17	18	19	20	21	22	23	24	25
R	.23	.20	.22	.31	.30	.16	.18	.18	.22	.40	.35	.37	.35
N	527	527	542	191	192	399	392	392	391	165	166	158	158
P	.01	.06	.02	.13	.04	.63	.43	.42	.13	.01	.07	.05	.11
	26	27	28	29	30	31	32	33	34	35	36	37	
R	.32	.31	.28	.36	.25	.34	.35	.32	.38	.40	.27	.40	
N	159	159	158	158	151	122	122	117	117	117	120	122	
P	.24	.28	.48	.07	.76	.37	.30	.54	.20	.12	.81	.11	

Table 25

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:
WAVE 2 SOO INDEXES AS PREDICTORS OF ABS BY MONTH

	ABS MONTHS												
	1	2	3	4	5	6	7	8	9	10	11	12	
Entire Sample													
R	.76	.33	.35	.41	.34	.34	.33	.21	.31	.36	.21	.27	
N	24	147	147	375	375	432	432	211	211	317	309	424	
P	.47	.23	.17	.01	.01	.01	.01	.76	.08	.01	.43	.01	
	13	14	15	16	17	18	19	20	21	22	23	24	25
R	.30	.40	.84	.40	.26	.49	.35	.69	.75	.53	.50	.60	.68
N	314	81	24	274	267	267	267	41	41	41	41	41	41
P	.01	.46	.15	.01	.15	.01	.01	.08	.01	.66	.76	.33	.11

Curvilinearity. It is at least possible that the multiple regression coefficients which we have obtained understate the real relationships which exist between SOO indexes and performance because those true relationships are in some fashion curvilinear. An accepted method of testing for curvilinearity is to compare correlation ratios with product-moment coefficients obtained for the same data set (McNemar, 1969). Multiple classification analysis has been developed as a multivariate technique analogous to multiple regression, yielding as well partial correlation ratios (Andrews, et al., 1973). In the present instance, one would expect curvilinearity to evidence itself in the form of larger multiple coefficients from multiple classification analysis than from multiple regression. To test this, three periods of data for TVE and for ABS were submitted to multiple classification analysis, using all 13 SOO indexes as predictors. The results are presented in Table 26, which compares multiple prediction coefficients from the two procedures. As these findings indicate, there is little evidence of substantial curvilinearity present in the relationships.

Table 20

MULTIPLE COEFFICIENTS FROM MULTIPLE CLASSIFICATION ANALYSIS AND MULTIPLE REGRESSION PROCEDURES, FOR SELECT PERIODS

Period	Coefficients			
	TOTAL VARIABLE EXPENSE		ABSENCE	
	Multiple Classification Analysis	Multiple Regression	Multiple Classification Analysis	Multiple Regression
B	--	--	.39	.30
C	.33	.34	.30	.33
D	.22	.27	--	--
E	.26	.27	.28	.34

DISCUSSION

The two general research questions posed at the outset of the Results section appear to have been answered rather conclusively. Multivariate relationships of respectable magnitude do occur, and they do cross-validate. An estimate of the lag time involved for organizations of the type focused upon in the present study is at least approximated. Furthermore, certain possible concerns seem to have been unwarranted. Unreliability in both predictors and criteria does not appear to present a serious limitation: internal consistency reliability coefficients for both types of measures are quite high, and the multiple correlation coefficients between them do not appear to encounter an upper "barrier."

Second, the possibility that relationships might not occur in some sites which nevertheless had reliable survey and performance measures was not realized. Instead, we find that the magnitude of relationships between survey and performance measures appears to be constrained by the extent to which the organization is capital intensive.

Third, there is no evidence of significant curvilinearity present in the relationships between survey predictors and performance criteria. Multiple coefficients generated by a non-linear procedure appear to be almost identical to those produced by a linear method.

Finally, collapsing performance into multi-month periods does not appear to have done drastic damage to the relationships. Indeed, it appears to have improved the reliability of our predictions.

While these concerns appear to be no longer justified, therefore, there are other factors which do appear to have reduced the magnitude of the obtained coefficients by removing portions of relevant variance. One of these is the imputation process, by which we assigned the performance scores for a cost center to all of the non-supervisory work groups that comprise it. While in reality the various groups in a particular cost center no doubt contributed differentially to its measured effectiveness, the measuring system does not record their differences. This artificially increases the number of tied performance scores, thereby reducing variance in the criterion measures. For this reason, the multiple correlation coefficients understate by an unknown amount the true relationships which exist between a work group's human organizational conditions and its performance.

Another factor potentially reducing our obtained relationships is the standardization process whereby each work group's performance measure was converted to a standard score in its own distribution for that particular period. Not only does this procedure remove real variance that in theory exists between organizations and which would perhaps enhance our obtained coefficients (there are differences in human organizational characteristics among the firms which produce correlated differences in performance, but the latter is removed), it also removes real variance among cost centers across periods.

For all of these reasons, therefore, we must keep in mind that the multiple correlation coefficients obtained in the present study understate the true values that exist and represent a conservative estimate of their strength.

In this context, the pattern of obtained relationships must be regarded as particularly reassuring. Statistically significant multiple correlation coefficients are obtained in proportions far outweighing chance. Using Wave 1 survey data to predict total variable expense, coefficients were obtained which range from .27 to .70. Similar predictions to absenteeism rate yielded a range of coefficients from .20 to .53. For both measures, predictions using Wave 2 survey data produced ranges varying only slightly from these values.

Lag time estimates contain elements that both confirm and expand our expectations. While the rise and fall in obtained relationships are not as dramatic as our hypothetical chart might have depicted them, they are there. Peak relationships appear to occur 17 to 26 months after SOO Wave 1 and two and one-half to three years after the presumed onset of the conditions measured by that Wave. The results were strikingly similar for absenteeism rate. In the case of the latter measure (absenteeism), though not for total variable expense, there was evidence to suggest some amount of "reciprocal causation," that is, improved organizational practices as a response to an earlier high absenteeism rate.

An ancillary finding is that social system constancy, rather than change, appears to exist. Social system similarity between the two waves of survey data was quite strong, despite rather substantial efforts which in each instance coincidentally went on to attempt to improve those systems.

Pulling these various findings together, it would appear that five concepts are required to explain the data. First, there are concurrent effects, significant relationships to performance whose time period was more or less contemporaneous to the organizational conditions measured by a particular survey wave. Second, there are predictive effects, significant

relationships to performance in time periods subsequent to the organizational conditions measured by a particular survey wave and whose occurrence reflects the fact of lag time. Third, there is the shadow effect, the occurrence of similarly shaped curves for adjacent survey waves, defining their relationships to the same performance periods and attributable to the apparent tendency of social systems to remain rather invariant across time. Fourth, there is what we have termed reciprocal causation, for which evidence in the present study occurred for the absenteeism measure and which in all likelihood occurs for other outcomes as well. In addition to the postulated main effects of organizational practices causing performance, there is a normal responsiveness of the social system to earlier performance (particularly to depressed performance). Fifth, there is outcome closeness versus remoteness, reflecting the place of the various measures in an events sequence (organizational practices versus outcomes, penultimate and ultimate).

Finally, it seems appropriate to comment on the analysis itself. The double cross-validation design is, we feel, particularly rigorous. It helps to assure that the results would generalize to other, similar settings and that the findings do not simply capitalize upon characteristics of a particular sample.

In this connection, it should be noted that, while the organizations included in these analyses do not cover the entire spectrum of American work life and are civilian rather than military, they do resemble the Navy in many ways:

(1) in varying degrees they are large, complex, and oriented around expensive hardware;

(2) the work is, except in administrative sectors, hot, heavy, demanding, and dirty;

(3) each is a part of a larger entity which depends upon it in some measure for its performance.

The shortcomings of the present analyses would appear to center around the absolute magnitude of the obtained coefficients. They would appear to explain no more than 25 percent of the variance in performance among cost centers. Of course, perspectives on the meaning of this percentage may vary: it may be seen as "only 25 percent;" on the other hand, to be able to explain (and presumably affect) 25 percent of performance variance is no mean feat.

Still the percentage requires explanation. While the theory from which we work seems at least acceptable comprehensive, it is obvious that a large portion of performance variance remains to be explained. Obviously, not all possible predictors are included in the present array, and the addition of other variables might improve our ability to predict.

Despite this obvious possibility, it is worth reiterating the fact that several facets of our procedure deliberately removed or excluded potentially relevant criterion variance. There is the very real possibility -- indeed the likelihood -- that a much higher portion of performance variance would be accounted for were those additional portions included in our criterion measures.

On the basis of the findings, therefore, we feel that the basic requirements for constructing future performance trend indicators -- a current value approach to human resources accounting -- have been met:

(1) Key dimensions of the human organization have been identified and accurate measurements thereof obtained.

(2) Reliable, valid indicators of organizational effectiveness have been obtained and refined.

(3) Relationships between key dimensions of the human organization and performance have been established.

(4) At least ancillary evidence supporting the durability of changes in organizational functioning has been obtained. System stability, not erratic fluctuation, seems to be the rule.

Accordingly, the research effort will turn toward two lines of necessary extension:

- The analyses just reported will be replicated, as far as possible, using Navy survey and performance data (already in hand, from earlier studies).
- For the present civilian data sets, a start will be made in the value attribution phase. This will involve converting inter-wave survey changes (modest though they may be) into changes in dollar-value of future performance. Capitalized and discounted, these changes then will represent gains and losses in the current value of the human organization.

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